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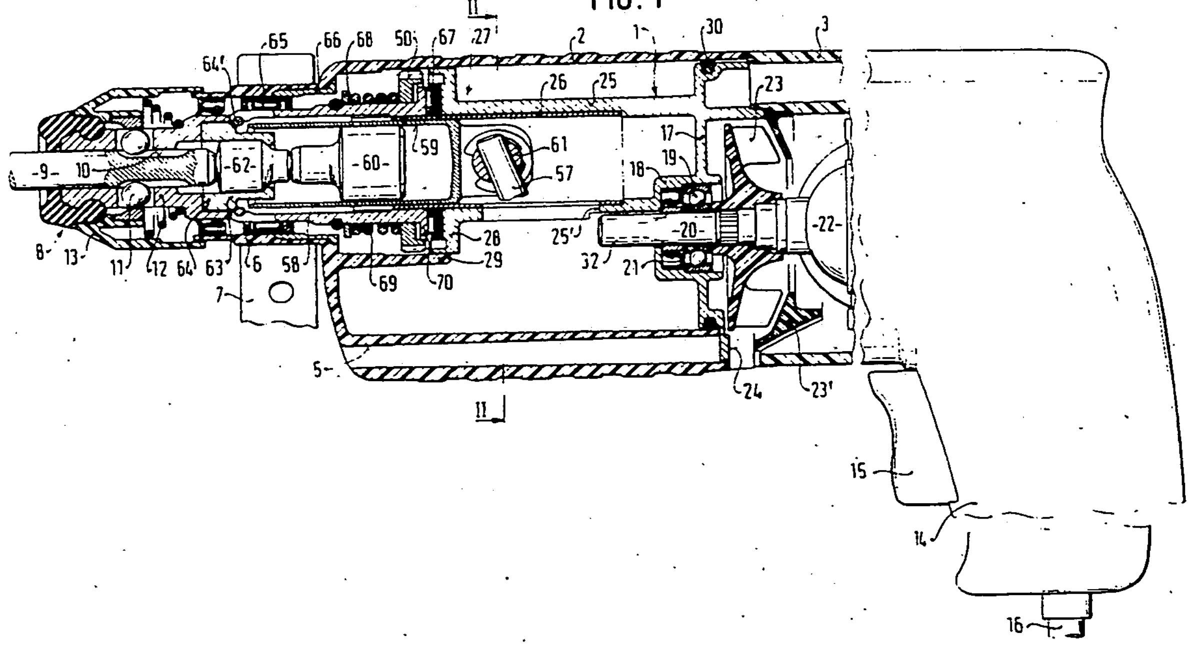
(54) A hammer drill

(57) An electrically driven hammer drill comprising s tool head 8 influenced by an air cushion percussive mechanism 27, is provided with a plastics housing 2, 3 accommodating a metallic intermediate housing 1. The intermediate housing preferably consists of a metal with good heat conducting properties, such as aluminium. All movable parts of the hammer drill (motor shaft 20, intermediate shaft 34, percussive on-off switching means 51-59 and percussive mechanism 27) cooperating with each other are mounted in the said intermediate housing 1. In this way, a very small, completely insulated hammer drill which is economic to produce is made possible. In order to achieve greater operational reliability, all parts of the hammer drill cooperating with one another are permanently and non-displaceably connected to one another. The heat produced in the bearings of the said parts is well distributed and dissipated by the intermediate housing. This is preferably assisted by the cooling air stream generated by the fan 23 of the hammer drill and which flows past the intermediate housing 1.

FIG. 1



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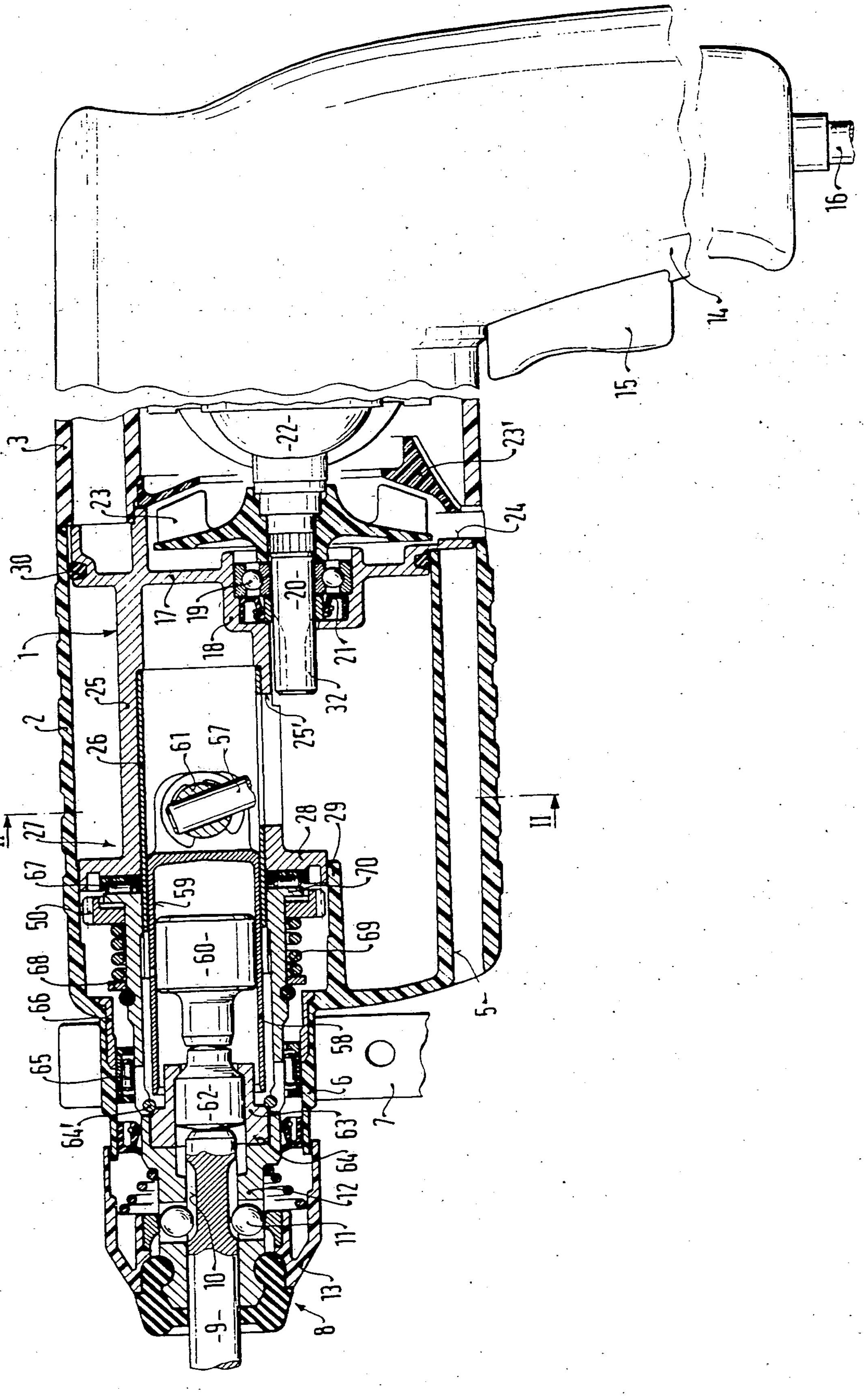


FIG. 1

FIG. 2

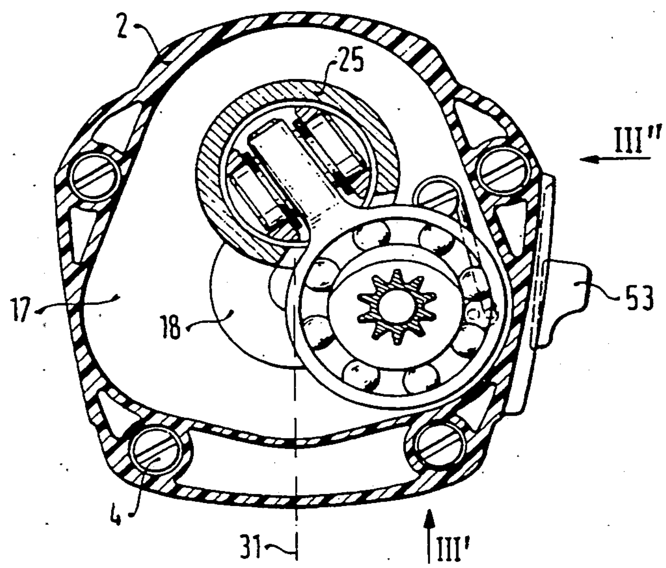
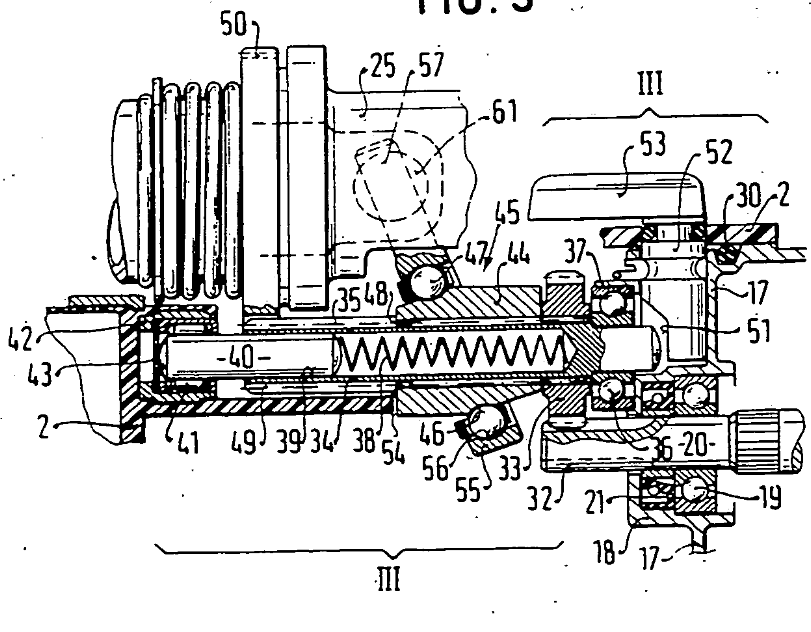

2
25
III"
53
17
18
4
31
III'

FIG. 3


50
25
57
61
III
53
52
30
2
45
47
44
37
35
48
17
51
42
-40-
43
2
41
49
39
34
38
54
46
56
55
33
36
-20-
32
21
19
18
17
III

SPECIFICATION

A hammer drill

State of the art

The invention originates from an electrically driven hammer drill according to the preamble to the main claim. A hammer drill of that kind is already known from German OS 22 52 951 (R. 1182). Also with this known hammer, which operates very satisfactorily as such, a plurality of operations are arranged in one bearing pedestal. It has certainly been shown that a clean alignment of all cooperating elements of the hammer drill, that is to say of the electric motor, the drive mechanism which can be switched off and of the drive generating the to and fro movement of the percussive mechanism and also of the percussive mechanism itself, can only be arrived at with a considerable manufacturing outlay. Moreover, it has been shown that the heat generated by the percussive mechanism may only be dissipated with difficulty under certain operating conditions.

Advantages of the invention

As opposed to this, the hammer drill in accordance with the invention comprising the characterising features of the main claim has the advantage, whilst retaining the plastics construction very favourable from the economical point of view, it is nevertheless distinguished by considerable operational reliability. This is achieved on the one hand due to the fact that all movable elements of the hammer drill are arranged in a single intermediate housing in an unvariable position with respect to each other. The heat developed in the region of the percussive mechanism by the compression of the air cushion and by friction is likewise conducted into the intermediate housing where it can be distributed and easily dissipated in the motor cooling air.

Advantageous further developments and improvements of the hammer drill set forth in the main claim are made possible by the measures set forth in the sub-claims. It is of particular advantage for the intermediate housing to be formed by an intermediate wall on which is formed a tubular extension receiving the percussive mechanism. Moreover, it is very preferable for the end of the tubular extension to be provided with a flange, especially a moulded on flange, which forms the axial bearing for the tool holder tube of the hammer drill.

Drawing

An embodiment of the invention is illustrated in the drawing and is described in detail in the following specification. *Figure 1* shows a hammer drill in partial section, *Figure 2* is a cross-section along II-II in Figure 1 and *Figure 3* is a development of the drive.

The development of the drive illustrated in Figure 3 includes two partial sections rotated in the plane of the drawing about the axis of the intermediate shaft. The directions of view are referenced in Figure 3 by III′ and III″; the corresponding regions are similarly referenced in Figure 2.

Description of the embodiments

The illustrated hammer drill has an intermediate housing 1 made of metal with good heat conducting properties - in this case aluminium - and which is arranged in an outer plastics housing. The plastics housing consists of two substantially cup-shaped parts 2,3 which, whilst covering the intermediate housing 1, are fixed thereto and to one another by bolts 4 (Figure 2). In known manner, the bolts 4 are accessible from the outside through housing recesses 5. At its forward end, the forward portion 2 of the plastics housing changes into a cylindrical neck 6 which is designated for fixing additional devices - in this case an additional hand grip 7. A tool holder 8 which serves for the reception of a drill 9, is arranged on the hammer drill at the forward end of the housing extension 6. The shank of the drill 9 has two closed longitudinal grooves 10, one on each side, in which engage radially displaceable locking elements formed as balls 11 in the tool holder 8. The balls are guided in radial bores in a tool holder tube 12 and are prevented from radial movement by means of a spring loaded sliding sleeve 13. As can be appreciated from Figure 1, the drill 9 can be moved axially in the tool holder tube 12. The possible length of this axial movement is determined by the axial length of the longitudinal grooves 10. A pistol hand grip 14 is moulded onto the part 3 of the plastics housing at the rear end remote from the tool holder 8. A switch provided with a push button 15 through which the drill hammer can be set in operation, is incorporated in the pistol hand grip 14. A current supply cable 16 passes through a resilient sleeve at the lower end of the piston hand grip 14.

The intermediate housing 1 consists essentially of a transverse wall 17 in which is arranged somewhat centrally a bearing seat 18 for a front bearing for an armature shaft 20 of an electric motor, formed as a ball bearing 19. For sealing, a lip type oil seal is also arranged in the bearing seat 18. The electric motor, of which substantially only the front portion is illustrated in the drawing, is arranged on the side of the transverse wall 17 of the drive housing 1 remote from the tool holder 5. A fan wheel 23 which blows the cooling air passing the transverse wall 17 through slots 24 into the atmosphere, is also arranged on the armature shaft 20 between the ball bearing 19 and the laminated armature core 22. An air guiding ring 23′ is associated with the fan wheel 23 and is retained in its position in the portion 3 of the plastics housing by the intermediate housing 1 or the transverse wall 17.

On the side remote from the electric motor, the transverse wall 17 carries a tubular extension 25 in which is arranged a cylindrical slide bush 26 for an air cushion percussive mechanism 27. The wall of the tubular extension 25 has an axially parallel extending slot 25′. The slide bush 26 consists of a known multi-layer material: a, for example PTFE containing sintered material layer is applied to the cylindrical wall of a steel or bronze bush. At its forward end facing the tool holder 8, the tubular extension 25 bears a flange 28 which supports the intermediate housing 1 at its forward end engaging

in a tubular fitting 29 in the interior of the forward portion 2 of the plastics housing. As can be appreciated from Figure 1, the intermediate housing 1 is supported at the other end through the transverse wall 17 on the inner surface of the rear portion 3 of the plastics housing to which it is fixed by the bolts 4. An O-ring 30 is inserted in an annular groove in the outer edge of the transverse wall 17 and contacts the inner wall of the housing shell 2 with slight pretension. Thus, the interior of the forward housing portion 2 is separated from the interior of the rear housing portion 3 and sealed as regards lubricant.

It can be seen in Figure 2 of the drawing that the tubular extension 25 and the bearing seat 18 in which the armature shaft 20 is guided concentrically, are arranged in the longitudinal central plane 31 of the hammer. The end of the armature shaft 20 mounted in the ball bearing 19 carries a motor pinion 32. The motor pinion 32 meshes with a gear wheel 33 which is fixed to an intermediate shaft 34 for rotation therewith. The intermediate shaft 34 which is displaced laterally with respect to the longitudinal central plane 31, is splined externally at 35 over its entire length and its end facing the transverse wall 17 is mounted in a deep groove ball bearing 36. Since the external spline 35 is ground off in the region of the deep groove ball bearing 36, the intermediate shaft is supported in the position illustrated in Figure 3 by the resulting shoulder at the inner ring of the deep groove ball bearing 36. The outer ring of the deep groove ball bearing 3 is retained in a correspondingly formed receiver 37 which is moulded onto the transverse wall 17. Moreover, the outer ring of the deep groove ball bearing 36 is supported at the base of the receiver 37 in such a manner that axial forces transmitted by the intermediate shafts 34 can be conducted into the transverse wall 17. A bore 39, in which is arranged a spring 38, is provided coaxially in the end of the intermediate shaft 34 remote from the deep groove ball bearing 36. The forward end of a shaft portion 40 which can be pushed into the bore 39 telescopically against the force of the spring 38, extends from the free end of the bore 39. Moreover, the free end of the shaft portion 40 is supported in a needle bearing 41. The end of the shaft portion 40 is held axially by the spring 38 against a plate 43 arranged at the base of a bearing receiver 42 for the needle bearing 41. The bearing receiver 42 is formed on the forward portion 2 of the plastics housing which can consist of a glass fibre reinforced plastics material.

A hub member 44 of a swash plate drive 45 for the air cushion percussive mechanism 27 is rotatably arranged on the intermediate shaft 34. On its outside, the hub member 44 has a single annular continuous track groove 46 for balls 47 lying in a plane inclined with respect to the axis of the hub member 44. The hub member 44 is removably connected to the intermediate shaft 34 by means of positive coupling elements. In its turn, the outer spline 35 on the intermediate shaft 34, in which engages a short annular inner spline 48 in the bore of the hub member 44, serves as a coupling element.

The driving pinion 33 provided with a corresponding inner spline connection is mounted for rotation with but axially displaceable on the intermediate shaft 34 at the end of the outer spline 35 facing the deep groove ball bearing 36. As can be appreciated from Figure 3 of the drawing, the teeth of the outer spline 35 in the region in which the hub member 44 and the driving pinion 33 are arranged on the intermediate shaft 34, are reduced in height with respect to the height of the teeth over the remainder of the intermediate shaft 34. The transition from the reduced to the unreduced height of the teeth forms an axial abutment for the hub member 44 at its end remote from the driving pinion 33, that is to say, at the inner end of the spline 48. The bore in the hub member 44 is, of course, fitted to the reduced height of the teeth of the outer spline 35 on the intermediate shaft 34. In the position illustrated in Figure 3, in which the outer spline 35 on the intermediate shaft 34 is in engagement with the inner spline 48 of the hub member 44, the spring 38 then urges the intermediate shaft together with the axial abutment (transition from reduced to unreduced tooth height) against the hub member 44. This is axially supported once again by the driving pinion 33 which engages the inner ring of the deep groove ball bearing 36.

The teeth of the outer spline 35 on the intermediate shaft 34 are suitably shaped for transmitting rotary motion, in this case are substantially involute. Thus, the forward portion of the spline remote from the deep groove ball bearing 36 and which has the teeth of unreduced height, can form the driving pinion 49 of the intermediate shaft 34. This driving pinion 49 meshes with a gear wheel 50 which then rotates the drill 9 held in the tool holder 8.

In the position illustrated in Figure 3, the hub member 44 is located in the coupled position in which it is rotated by the intermediate shaft 34. In order to then interrupt the rotary connection between the intermediate shaft 34 and the hub member 44, that is to say put the air cushion percussive mechanism 27 out of action, the intermediate shaft must be pushed forwards towards the tool holder 8. For this purpose, externally actuable switching means are provided which permits the said decoupling of the percussive mechanism. These switching means are formed as an eccentric 51 on a switching shaft 52. The switching shaft is guided in an associated bearing bore which is formed in the transverse wall 17. In the operative position of the hammer drill, the axis of the switching shaft 52 and with it also the bearing bore lies horizontal. At its outer end projecting from the housing of the hammer drill, the switching shaft 52 carries an actuating knob 53 (Figures 2 and 3). As Figure 3 shows, the switching eccentric 51 is designed in such a manner that it does not contact the rear rounded end of the intermediate shaft 34 projecting out of the deep groove ball bearing 36 in the position in which the percussive mechanism 27 is switched in. Only by rotating the actuating knob 53 through 180° out of the position illustrated in Figure 3 does the outer surface of the switching shaft 52 come into contact with the rounded end of the intermediate shaft 34 so that it is finally pushed forwards against the force of the spring 38. In so doing, the axial pretensioning of the hub member 44 against the housing portion 2 of

the hammer drill through the gear wheel 33, is then removed. During the forward movement of the intermediate shaft 34, the forward end of the hub member 44 comes into contact with an abutment 54 formed by a part of the housing portion 2, whereby its axial movement is restricted. In this way, the inner spline 48 on the hub member 44 is finally released from the outer spline 35 on the intermediate shaft 34; thus, the rotary connection between the intermediate shaft and the hub member 44 of the swashplate drive is interrupted. However, further rotation of the intermediate shaft rotates the gear-wheel 50 so that a purely drilling operation is possible with the hammer drill. Thus, the switching eccentric 51 is only loaded in an axial direction when the air cushion percussive mechanism is switched off when there are no stresses on the machine therefrom. When the percussive mechanism is switched in, the switching eccentric 51 is fully loaded by the force of the spring 38. The spring force is available for the complete elimination of the axial clearance at the hub member 44. In this manner, a minimal development of noise is achieved in the first place. In the second place, due to the resilient pretensioning of the hub member 44 against the housing of the hammer drill, complete axial freedom is guaranteed - not only due to manufacturing tolerances but also due to the occurrence of wear.

The track 46 on the hub member 44 is associated with a track 56 cut on the inside of a ring 55, between which are guided the balls 47. In order to maintain the balls at a definitive spacing, they are guided by a cage known with ball bearings. A wobble pin 57 is made integral with the ring 55 and drives the air cushion percussive mechanism 27 of the hammer drill to and fro through the slots 25′.

The percussive mechanism of the hammer drill is arranged inside the stationary slide bush 26 arranged inside the stationary slide bush 26 arranged in the tubular extension 25. It consists of a pot piston 58 preferably made of aluminium, sealingly and slidingly guided in the slide bush 26 and in the cylindrical bore 59 of which is arranged a striker 60 formed as a floating piston likewise sealed and sliding. The rear end of the pot piston 60 remote from the tool holder 8 is formed as a fork and carries a pivot pin 61. A transverse bore is provided centrally in the pivot pin 61 in which the wobble pin 57 engages with a slight clearance. Thus, the wobble pin 57 can easily move in an axial direction in the transverse bore. The inner end of an intermediate dolly 62 extends into the forward end region of the bore 59 remote from the wobble pin 57. The intermediate dolly is axially guided for movement in a supporting sleeve 63.

The forward rounded end of the intermediate dolly 62 engages the rear end of the drill 9 axially movable in the tool holder 8 but held against rotation. The supporting sleeve 63 is fixed in the interior of the tool holder tube 12, where it abuts against an annular shoulder 64, by a snap ring 64′.

The tool holder tube 12 is mounted in the housing neck 6 of the housing portion 2 by means of a needle bearing 65, wherein the housing neck 6 is reinforced by a metallic reinforcing ring 66. The rear end of the tool holder tube 12 is supported on the flange 28 of the tubular extension 25 through an axial needle bearing 67. In its rear region facing the axial needle bearing 66, the tool holder tube 12 is guided in a radial direction on the end of the slide bush 26 projecting from the tubular extension 25.

The gear wheel 50 is rotatably mounted on the cylindrical outer wall of the tool holder tube 12. The body of the gear wheel 50, which carries on its motor side end surface coupling claws, is maintained in engagement with the associated coupling claws on the rear flange 70 of the tool holder tube 12 by a compression spring 69 abutting against a snap ring 68 which is inserted in an associated groove in the outer surface of the tool holder tube 12. In so doing, the strength of the compression spring 69 is so calculated that, under normal drill torque through the coupling claws, the gear wheel 50 is maintained in engagement with the rear flange of the tool holder tube. Only on attaining the predetermined response torque is the rotary connection between the gear wheel 50 and the tool holder tube 12 interrupted.

As can easily be appreciated, a rotary movement of the hub member 44 generates a reciprocating movement of the pot piston 58. The striker is likewise subject to an axial to and fro movement through the air cushion, which acts as an energy store, formed between the pot piston 58 and the striker 60. In the position illustrated in Figure 1, the percussive mechanism is set for percussive operation: the drill is applied to the wall, for example, to be drilled. By means of the pressure force applied by the operator, the shank of the drill 9 is held against the intermediate dolly 62 which is pushed into the axial bore of the supporting sleeve 63 up to the annular rib. On striking the intermediate dolly 62, the axially reciprocating striker 60 gives us its energy which finally becomes effective in the form of an axial impact on the tool held in the tool holder 8. Moreover, the drill is rotated through the above-described safety coupling consisting of the gear wheel 50 and the rear flange 70 on the tool holder tube 12.

The percussive mechanism can be taken out of operation in the above-described manner by actuation of the eccentric 51 arranged on the switching shaft 52. Since, in this case, the air cushion percussive mechanism is completely at rest, an absolutely vibration-free is achieved in the course of a drilling operation that is to say when the percussive operation is stopped. It has been shown, that the swashplate drive can be switched in in each operating condition of the hammer drill.

CLAIMS

1. An electrically driven hammer drill comprising a plastics housing accommodating a metal intermediate housing, the plastics housing having a tool head influenced by an air cushion percussive mechanism which can be switched off by switching means actuable from the outside, which tool head can be driven rotationally by a drive including an intermediate shaft, wherein the axes of the electric motor, the intermediate shaft, the percussive

mechanism and the tool head are arranged parallel to one another, characterised in that, the motor shaft, the intermediate shaft, the switching means and the percussive mechanism are mounted in a single intermediate housing, preferably of a metallic material with good heat conducting properties such as aluminium.

2. A hammer drill according to claim 1, characterised in that, the plastics housing consists of two substantially pot shaped portions, overlapping the intermediate housing and connected to the housing and to one another, preferably by bolts.

3. A hammer drill according to claim 2, characterised in that, the intermediate housing adjusts the position of an air guiding member in the rear portion of the plastics housing.

4. A hammer drill according to claim 1 or 2, characterised in that, the intermediate housing is formed by an intermediate wall onto which is moulded a tubular extension accommodating the percussive mechanism.

5. A hammer drill according to claim 4, characterised in that, the percussive mechanism is sealingly slidingly guided in a slide bush which is arranged in the tubular extension, preferably with a force fit.

6. A hammer drill according to claim 2 and 4 or 5, characterised in that, the intermediate wall is sealingly inserted in the plastics housing preferably by using an O-ring inserted in an annular groove extending around the intermediate wall (17).

7. A hammer drill according to claim 6, characterised in that, the intermediate wall separates the inner space of one housing portion accommodating the drive from the inner space of the other housing portion accommodating the electric motor.

8. A hammer drill according to claim 5, characterised in that, the slide bush projects from the end of the tubular extension facing the tool head and which is supported in the plastics housing and forms a radial bearing for a rotatably drivable tool holder tube receiving the tool.

9. A hammer drill according to claim 8, characterised in that, the end of the tubular extension is provided with a flange preferably moulded on which forms the axial bearing for the tool holder tube.

10. A hammer drill according to one of the preceding claims, characterised in that, the percussive mechanism is reciprocated by a wobble pin of a swashplate drive arranged on the intermediate shaft, wherein the wobble pin engages through an elongate slot in the wall of the tubular extension.

11. A hammer drill according to one of the preceding claims, characterised in that, the cooling air flow generated by the fan is guided along the intermediate housing, preferably at the transverse wall.

12. A hammer drill substantialy as herein described with reference to the accompanying drawings.

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